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## *A PROSPECTIVE EVALUATION OF TELEMEDICINE IN REMOTE NAVAL POPULATIONS SEEKING SPECIALTY CARE*

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# **A Prospective Evaluation of Telemedicine in Remote Naval Populations Seeking Specialty Care**

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# **A Prospective Evaluation of Telemedicine in Remote Naval Populations Seeking Specialty Care**

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## **1.0 Summary**

The focus of this study was the clinical impact of ear/nose/throat (ENT) consultations conducted via video teleconferencing (VTC) during a planned, 4-month study period. This study included structured interviews with TRICARE Region 9 physicians and nonphysician medical personnel. The interview information was used to compare and contrast the attitudes of users and measure their recent use of telemedicine.

### **1.1 Background**

This study was a follow-up to a previous retrospective evaluation of the telemedicine network in TRICARE Region 9. This research responds to a specific naval directive to study the potential of telemedicine technologies such as the Internet and live VTC for shipboard medical departments. Since limited opportunity exists to study telemedicine use at sea, the aim of this research was to evaluate current telemedicine use in remote military treatment facilities (MTFs) ashore with limited access to specialty care. The results will be useful to guide future telemedicine applications for different types of ships and medical providers.

### **1.2 Method**

This study was a prospective evaluation of ENT consultations that were conducted by an ENT specialty physician via VTC. These VTC sessions were conducted by the specialist from the Naval Medical Center, San Diego (NMCSD) for patients/providers at remote MTFs in TRICARE Region 9 and Lemoore Naval Air Station (NAS), Lemoore, CA. Observations were recorded during a planned 4-month study period (November 1, 2000, to March 1, 2001). All consultations were scheduled and recorded using the TRICARE Region 9 Internet Web site, the Referral Management System (RMS).

Data sources included the RMS and structured interviews with physician and nonphysician medical personnel in the TRICARE Region 9 telemedicine network. The RMS captured data on various factors related to telemedicine use (e.g., patient history, MTF) and clinical impact (provider and consultant diagnosis). The interview questions assessed general attitudes and recent experiences with telemedicine.

### **1.3 Results**

A total of 193 ENT consultations were conducted via VTC following referrals from primary providers. The patients were mostly young, active-duty military personnel. Of these consultations, 45% led to a change in diagnosis by an ENT specialty physician relative to initial diagnosis by the referring provider. This rate of clinical impact generalized across different ENT conditions (tonsil, upper respiratory, hearing), age, gender, military status (e.g., active duty or dependent) and MTFs.

Medical personnel reported generally positive attitudes on telemedicine technologies and the telemedicine process in TRICARE Region 9. The nonphysicians reported slightly more favorable attitudes and used telemedicine more often and in more ways than the physicians. Medical personnel noted some specific limitations in satisfaction with technologies (e.g., VTC sound), the telemedicine process, and the RMS.

#### **1.4 Conclusions**

The ENT consultations via VTC had substantial clinical impact. This was true for a variety of ENT conditions among military personnel and dependents at remote MTFs where patients had limited access to this medical specialty. These results replicated and extended the findings of a recent retrospective study of the TRICARE Region 9 telemedicine network.

The medical personnel noted that the RMS functioned well in coordinating the telemedicine consultations for ENT. They were generally satisfied with the telemedicine technology and process. Compared with physicians, nonphysicians made more extensive use of telemedicine and reported slightly more favorable attitudes toward satisfaction with telemedicine than the physicians. The specific limitations of telemedicine are discussed along with recommendations for further work.

## 2.0 Introduction

Increasingly, it has become clear that the effective application of telemedicine technologies such as email, the Internet, and live VTC is essential for the U.S. armed forces to optimize their healthcare mission (Patel, 1994; Stoloff, Garcia, Thomason, & Shia, 1998; Vidmar, 1999; Walters, 1996). This is especially true for personnel deployed or stationed in remote environments (e.g., Cubano et al., 1999; Nice, 1987). Telemedicine can benefit the Navy by providing timely access to specialized care for patients and medical personnel on ships at sea with limited resources (Nice, 1987). Telemedicine use provides many benefits (Bashshur, Reardon & Shannon, 2000; Jerome et al., 2000; Sinha, 2000), and these benefits extend to personnel and their dependents stationed at MTFs in medically underserved regions ashore (e.g., HRSA, 1997; Melcer, Crann, Hunsaker, Deniston, & Caola, 2001).

This research responds to a specific Navy research directive to determine how telemedicine technologies could be used by shipboard medical departments of various sizes (Patel, 1994). Larger ships, such as carriers and amphibious ships, have extensive medical departments including physician and nonphysician personnel to perform the functions of a small hospital (e.g., surgery). Some ships currently have telemedicine technologies installed, such as the Internet, VTC, and computed radiology.

Unfortunately, few evaluation studies of the shipboard telemedicine process exist, and they are limited to these large ships (e.g., Larson, Burr, Pearsall, & Silva, 1998). Moreover, no telemedicine capabilities currently exist on small ships, such as cruisers and destroyers, to assist limited medical departments headed by independent duty corpsmen (IDCs) (Nice, 1987). Thus, it is useful to study telemedicine where it is currently used at MTFs of various sizes ashore. The field of telemedicine in general needs more systematic evaluation studies (Brender, Nohr, & McNair, 2000).

The present study was a follow-up to a retrospective study of the first 2.5 years of telemedicine network operation in TRICARE Region 9 (Melcer et al., 2001). In TRICARE Region 9, remote MTFs, such as Fort Irwin and Port Hueneme, access specialty care by physicians at NMCS D via live VTC. Telemedicine consultations are managed and recorded using the RMS, an Internet Web site.

The retrospective study showed that telemedicine use increased with the age (time since operational) of telemedicine systems at various MTFs or the age of individual telemedicine specialties (e.g., ENT). Most important, the retrospective study concluded that approximately half of ENT consultations had a clinical impact, measured by change in diagnosis.

The present study replicated the basic measures used in the previous work to test the reliability of the findings. The present study also extended the previous work in two important ways:

- Analysis focused on the ENT specialty, the most active telemedicine specialty in TRICARE Region 9, over a planned, 4-month study period. ENT conditions can pose a concern for shipboard medical departments (Blood & Griffith, 1990;

D'Alessandro, D'Alessandro, Hendrix, & Bakalar, 1999; Derderian & Blood, 1998), and little evaluation exists on the use of VTC for remote ENT consultations in MTFs (e.g., Blakeslee, Grist, Stachura & Blakeslee, 1998; Sclafani et al., 1999). The generality of these VTC procedures for different ENT problems and patient populations is unclear.

- Interviews with military medical personnel (e.g., general medical officers (GMOs), IDCs, and medical technicians) were conducted to obtain quantitative assessments of their attitudes and experiences with TRICARE Region 9 telemedicine. Telemedicine attitudes (e.g., satisfaction) and experience are associated with telemedicine use (Karp et al., 2000). Satisfaction with telemedicine and use of telemedicine were compared between physician and nonphysician medical personnel.

### **3.0 Method**

This was a prospective evaluation of telemedicine consultations that were conducted by an ENT specialty physician. The data are based on information extracted from the RMS database and from interviews with physician and nonphysician medical personnel. The study evaluates VTC consultations conducted over a planned 4-month study period for patients/providers at remote MTFs in TRICARE Region 9 and Lemoore NAS.

#### **3.1 Data Sources and Subjects**

Observations came from two sources:

- A database of telemedicine consultations
- Interviews with medical personnel

All personal identifying information (name, social security number) was excluded from the resulting database prior to analysis.

##### **3.1.1 RMS Database**

The telemedicine consultations ( $N = 193$ ) occurred between November 1, 2000, and March 1, 2001, and were extracted from the RMS database at NMCS D. These were all VTC sessions in which the primary provider referred a patient for consultation to an ENT specialist for initial evaluation. Postoperative and follow-up sessions were excluded from analysis, because these sessions usually do not function to determine diagnosis. These consultations were provided for patients treated at MTFs in TRICARE Region 9 and the MTF at Lemoore NAS. These facilities comprise the functional telemedicine network centered at NMCS D. Individual patients contributed 1 or more observations for 1 or more medical conditions.

##### **3.1.2 Medical Personnel**

A small sample of medical personnel from the TRICARE Region 9 telemedicine network completed telephone interviews. These were physicians ( $N = 7$ ) and nonphysicians ( $N = 7$ ), 10 males and 4 females. The physicians consisted of 2 GMOs, 3 primary care physicians and 2 specialty physicians (child psychiatry and



neurology). The nonphysicians consisted of 1 IDC, 4 medical technicians, 1 nurse, and 1 physician's assistant. All were in group practices ranging from 6 to 60 providers, with a median size of 8. Of the 14, 12 were on active duty and 2 were civilians. They were chosen based on referral by the telemedicine coordinator in TRICARE Region 9 and their availability for interview. At least 1 and as many as 4 medical personnel worked in each of 8 MTFs. The TRICARE Region 9 telemedicine network is detailed in Table 1.

### 3.2 TRICARE Region 9 Telemedicine Network

TRICARE provides healthcare for active-duty personnel, their qualified family members, Civilian Health and Medical Program of the Uniformed Services-eligible retirees, and the family and survivors of all uniformed services.

The lead agent for TRICARE Region 9 is located at NMCS D, along with the resources for specialized care (i.e., the consultant physicians). The telemedicine network in southern California includes 8 MTFs, most with limited medical specialization. Table 1 lists the MTFs in this network along with their start dates for telemedicine operations.

**Table 1**

***MTFs in the TRICARE Region 9 Telemedicine Network***

MTF	Network Designation (distance from hub facility, miles)	Start Date
NMCS D	Hub (0)	6/1/97
Port Hueneme	Spoke (182)	8/14/97
Fort Irwin <sup>a</sup>	Spoke (213)	10/17/97
Edwards AFB <sup>a</sup>	Spoke (201)	3/26/98
Vandenberg AFB <sup>b</sup>	Spoke (290)	11/12/98
Twentynine Palms	Spoke (174)	11/23/98
Los Angeles AFB	Spoke (121)	3/10/99
Lemoore NAS	Spoke (327)	9/16/99
Note. MTFs = military treatment facilities.		
<sup>a</sup> The ENT specialist was not certified during part or all of this study.		
<sup>b</sup> This facility was inoperative for 6 months due to technical difficulties.		

NMCS D functions as the "hub" of the telemedicine network. The remote MTFs are the "spokes" at various distances from NMCS D. While the Lemoore facility is not part of TRICARE Region 9, it is included in the present study because it is part of the functional telemedicine network centered at NMCS D.

Generally, the spoke MTFs seek telemedicine consultations from medical specialists at the hub MTF. This is true for ENT (start date: June 1997) and neurology (start date: February 1999). Psychiatry and rheumatology specialists are located at Twentynine Palms (start date: May 1999) and Fort Irwin (start date: May 1999), respectively. Such a "hub-and-spoke" telemedicine network model

has been applied frequently in recent years in many settings (Jerome et al., 2000; Nickelson, 1998).

### **3.3 Referral Management System**

In TRICARE Region 9, telemedicine consultations are managed and recorded via the RMS, an Internet Web site. For example, when a primary provider determines a patient requires a consultation, the patient is referred to a telemedicine coordinator. If the required specialty care is not available at the patient's MTF, the telemedicine coordinator (e.g., IDC or medical technician) will access the RMS to schedule a telemedicine consultation with a specialty physician, usually located at NMCSO. This determination is based on the availability of specialty care at individual MTFs and the availability of telemedicine consultants for the specialty.

The patient at the remote MTF is registered in the RMS with relevant personal background information, reported symptoms, and primary provider diagnosis. The RMS then allows the provider to make an appointment with a specialty physician at NMCSO who can access the patient's information for review.

The consulting physician is able to access his or her schedule of referred patients via the RMS. During the consultation itself, the telemedicine coordinator presents the patient to the consultant via telecommunication (usually VTC). Following the telemedicine appointment, the consultant enters comments on diagnosis and treatment in the patient's RMS record.

This study focused on telemedicine patients referred for initial evaluations by ENT specialists via VTC. The ENT specialty was chosen for analysis because it is the most active in TRICARE Region 9; initial evaluations via VTC were chosen because these are the sessions in which the primary provider and specialist interact to determine clinical outcomes for patient care (e.g., diagnosis). Thus, store-and-forward, preoperative or postoperative, or follow-up sessions were excluded, since these sessions usually do not function to determine diagnosis.

The following variables were recorded from the RMS:

- Patient demographics (age, gender, and military status)
- Reason for consultation (initial, preoperative, postoperative, follow-up, other)
- MTF where the patient received the telemedicine consultation
- Consultant medical specialization (ENT, neurology, psychiatry, rheumatology)
- Primary provider and consultant diagnosis
- Telemedicine modality (VTC or store-and-forward)

The ENT consultations included a diversity of problems. All cases were assigned to one of the following five major categories: hearing (e.g., tinnitus), sleep-related (e.g., sleep apnea), tonsil-related, upper respiratory (e.g., sinusitis), and

Integumentary (e.g., skin cyst). These categories were chosen based on discussion with the lead ENT specialist. Thus, it is possible to see the relative frequency of major ENT conditions in this population and determine whether the clinical impact of VTC consultations varies among these types of cases.

### **3.4 Interviews With Medical Personnel**

The medical personnel were asked to complete brief telephone interviews, approximately 10 minutes in length, to determine their medical backgrounds and experience with technology, and to assess their attitudes toward telemedicine. These interviews were conducted at the end of the study period and followed a structured survey questionnaire format. The questions appearing on the questionnaire and interview forms are based on those used in previous work at Naval Health Research Center (NHRC) (Larson et al., 1998). The format was influenced by Dillman's (1978) methodology for mail questionnaires.

The following variables were recorded from the interview forms:

- Medical positions (e.g., IDC, nurse, physician) and any specialization (e.g., dermatology, psychiatry)
- Years of past experience with various technologies (e.g., computer, modem, Internet, email)
- Medical purpose and years of past experience with telemedicine (e.g., telephone, RMS, fax, VTC)
- Attitudes toward telemedicine were assessed using a 5-point Likert rating scale (e.g., 1 = very satisfied, 2 = somewhat satisfied, 3 = undecided, 4 = somewhat dissatisfied, 5 = very dissatisfied). 5 to 7 questions were used to assess each of 4 different attitude variables:
  - Satisfaction with technologies (e.g., VTC, Internet)
  - Satisfaction with modalities (e.g., sound, images)
  - Usefulness of technologies
  - Perception of telemedicine

### **3.5 Data Analysis**

The data analysis was designed to address the following questions:

- What percentage of telemedicine consultations had an impact on clinical outcomes, namely a difference in diagnosis between the primary provider and specialty consultant?
- What variables were associated with changes in diagnosis?
- What were the attitudes and experiences of medical personnel regarding telemedicine? Were these attitudes and experiences related to the use or clinical impact of the telemedicine consultations in this study? Were attitudes related to the extent of medical training received by physician or nonphysician medical personnel?

A chi-square test ( $p < .05$ ) was used to test the association between ENT problem and change in diagnosis. Descriptive statistics are presented for the interview data. Preliminary trends are described for the interview data because of the small samples of 7 physicians and 7 nonphysician medical personnel. Thus, the comparisons between physicians and nonphysicians should be interpreted with caution.

## **4.0 Results**

A total of 193 ENT consultations were conducted via VTC following referrals from primary providers. Forty-five percent of these consultations led to a change in diagnosis by an ENT specialty physician relative to the initial diagnosis by the referring provider. This rate of clinical impact generalized across different ENT problems, age, gender, military status, and MTFs.

Medical personnel reported generally positive attitudes on telemedicine technologies and the telemedicine process in TRICARE Region 9. Compared with physicians, nonphysicians reported slightly more favorable attitudes and used telemedicine more often and in more ways.

### **4.1 Demographics**

The sample consisted predominantly of active-duty adult males between 18 and 44 years old (Table 2). The sample did include females and military dependents each representing approximately 30% of the total sample (Table 2).

**Table 2*****Patients Referred for VTC ENT Consultations***

<b>Total Consults</b>	<b>N</b>	<b>%</b>
	<b>193</b>	<b>100</b>
<b>Gender</b>		
Male	133	68.9
Female	58	30.1
Unknown	2	1.0
<b>Age, years</b>		
1-10	19	9.8
11-17	5	2.6
18-24	50	25.9
25-44	92	47.7
45-65	19	9.8
65+	7	3.6
Unknown	1	.5
<b>Military status</b>		
Active duty	132	68.4
Dependent	59	30.6
Unknown	2	1.0
<b>MTF</b>		
Lemoore NAS	110	57.0
Port Hueneme	48	24.9
Twentynine Palms	17	8.8
Fort Irwin	15	7.8
Edwards AFB	3	1.6

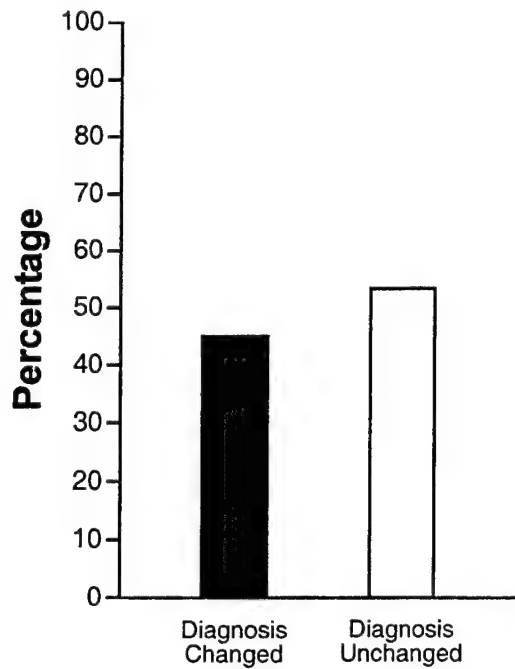
*Note.* ENT = ear/nose/throat; MTF = military treatment facility; VTC = video teleconferencing.

Over 75% of the consultations came from the Lemoore or Port Hueneme facilities. A delay in the certification of the ENT specialist by Fort Irwin and Edwards AFB limited telemedicine activity at these MTFs.

These variables will be considered further because they may influence the clinical impact of the ENT consultations.

#### **4.2 Clinical Impact**

The telemedicine consultations had a substantial clinical impact in the present sample of patients. Almost half (45%) of the consultations produced a change in patient diagnosis by the ENT specialist relative to the initial diagnosis of the primary provider (Figure 1).



**Figure 1. Clinical impact of VTC consultations.**

The relatively high rate at which the ENT consultations had an impact on patient diagnosis provides strong support for the utility of this telemedicine specialty.

Since the ENT cases included diverse medical problems (e.g., hearing- and sleep-related), this study also explored whether the overall rate of clinical impact (Figure 1) was general or limited to certain types of ENT problems, demographic (e.g., age, gender), or institutional variables (e.g., military or dependent status). Table 3 shows the clinical impact as a function of these secondary variables.

**Table 3**  
***Clinical Impact of VTC Consultations by Secondary Variables***

	Diagnosis Changed		No Change	
	N	%	N	%
<b>Overall summary</b>	<b>87</b>	<b>45</b>	<b>106</b>	<b>55</b>
<b>Type of ENT problem</b>				
Hearing/vertigo	23	46	27	54
Sleep	12	38	20	62
Tonsil	13	46	15	54
Upper respiratory	39	50	39	50
Integumentary	0	0	5	100
<b>Gender</b>				
Male	63	47	70	53
Female	23	40	35	60
<b>Age, years</b>				
1-10	6	32	13	68
11-17	2	40	3	60
18-24	22	44	28	56
25-44	43	47	49	53
45-64	9	47	10	53
65+	5	71	2	29
<b>Military status</b>				
Active duty	62	47	70	53
Dependent	23	39	36	61
<b>MTF</b>				
Lemoore NAS	48	44	62	56
Port Hueneme	26	54	22	46
Twentynine Palms	5	29	12	71
Fort Irwin	6	40	9	60
Edwards AFB	2	67	1	33
Note. Totals less than 193 cases reflect 1 or 2 missing cases for certain variables (e.g., 192 for age and gender, 191 for military status). VTC = video teleconferencing.				

Table 3 indicates that the clinical impact of the ENT consultations generalized across ENT problems, age, gender, duty status, and MTFs. No significant deviations occurred among the major ENT categories; none of the 5 integumentary cases led to changed diagnosis, but larger samples would be needed to determine the reliability of this effect. Similarly, no major deviations were seen within age, gender, military status, or MTF.

It is worth emphasizing that the active-duty cases and those 18-44 years old showed rates of clinical impact similar to those found in the overall sample. The lack of substantial variation within these 4 secondary variables supports the generality of the overall rate of clinical impact.

### 4.3 Interviews With Medical Personnel

Structured interviews of 7 physicians and 7 nonphysician medical personnel from the TRICARE Region 9 telemedicine network supplemented the RMS data on patient outcomes.

#### 4.3.1 Past Telemedicine Use

Table 4 shows the medical reasons for which the physician and nonphysician medical personnel said they had ever used telemedicine technologies. The primary reason given for past telemedicine use was to confirm diagnosis. All but 1 of the 14 medical personnel had at some point used each of the telemedicine technologies to confirm diagnosis.

The physicians and nonphysicians differed somewhat in past use of telemedicine for educational reasons (patient or provider). The nonphysicians were consistently more likely than physicians to use telemedicine for educational reasons. At least 70% of both groups had used the Internet for medical education.

**Table 4**

#### *Past Use of Telemedicine Technologies by Medical Personnel (N = 14)*

Telemedicine technology	Physicians		Nonphysicians	
	Diagnosis confirmation %	Education %	Diagnosis confirmation %	Education %
Telephone	100	43	100	76
Fax	86	10	100	40
Email	100	48	100	81
Internet	100	71	100	85
VTC	100	42	100	62
Overall average	97	43	100	69

Note. VTC = video teleconferencing.



#### 4.3.2 Current Access to Telemedicine Technologies

Table 5 shows that all nonphysicians and most physicians in TRICARE Region 9 had current access to various telemedicine technologies. All personnel reported well over 1 year of experience with each technology. Physicians and nonphysicians reported similar technology experience.

Table 5

*Current Access to Telemedicine Technologies by Medical Personnel*

Technology	Physicians		Nonphysicians	
	Current access %	Years used (M)	Current access %	Years used (M)
Email	71	5.1	100	3.0
RMS	71	1.4	100	1.7
Internet	71	3.1	100	3.6
VTC	71	1.7	100	1.7

Note. RMS = Referral Management System; VTC = video teleconferencing.

#### 4.3.3 Purposes of Telemedicine Use

Table 6 shows the reasons physicians and nonphysicians used telemedicine during the present study period (last 4 months).

More than two thirds of all telemedicine activity was initiated to confirm diagnosis. This was true for both groups. However, differences between physicians and nonphysicians were visible in the overall distribution of telemedicine purposes. The physicians were more likely than the nonphysicians to use telemedicine for provider education or technical support. In contrast, the nonphysicians were more likely to use telemedicine for patient education.

Table 6

*Recent Telemedicine Usage by Medical Purpose*

	Confirm diagnosis %	Patient education %	Provide education %	Technical support %	Unknown %
Physician	68	3	9	9	11
Nonphysician	77	16	1	1	5

#### 4.3.4 Telemedicine Activity and Satisfaction

Table 7 summarizes medical personnel reports of overall patient load and telemedicine activity during the present study period (last 4 months). Table 8 shows scores for medical personnel attitudes toward satisfaction, usefulness, and overall perception of telemedicine technologies (e.g., email, VTC) and

satisfaction with different modalities (images, sound, written text) transmitted by telecommunications.

**Table 7**

***Telemedicine Activity Reported by Medical Personnel***

<b>Telemedicine activity (last 4 months)</b>	<b>Physicians (Mdn)</b>	<b>Nonphysicians (Mdn)</b>
Telemedicine patients seen (TMED)	25	85
Total patients seen (TMED + non-TMED)	900	200
Telemedicine ratio (TMED/TMED + non-TMED)	3%	43%

**4.3.4.1 Level of Telemedicine Activity**

Table 7 indicates that nonphysicians reported substantially more telemedicine activity than physicians. This effect is seen both in the number of telemedicine cases and in the ratio of telemedicine cases to all patient care during the study period (telemedicine cases/telemedicine and non-telemedicine cases). Substantial variability occurred among both physicians and nonphysicians on these measures and the sample sizes were relatively small ( $N = 7$ ). To reduce the effect of extremely high or low scores, median scores are presented for telemedicine activity.

**4.3.4.2 Satisfaction With Telemedicine**

Table 8 indicates that all personnel reported consistently favorable attitudes toward telemedicine across all types of questions. They rated their attitudes on a 5-point scale, with more positive attitudes indicated by lower scores (e.g., 1 = very satisfied, 2 = somewhat satisfied, 3 = undecided, 4 = somewhat dissatisfied, 5 = very dissatisfied). Table 8 also indicates that the nonphysicians reported slightly more favorable attitudes than the physicians, as shown by mean scores. Although the size of this trend was small, it was seen for each of the 4 attitude variables (satisfaction with technologies, satisfaction with modality quality, usefulness, and perception).

**Table 8**

***Telemedicine Attitude Scores Reported by Medical Personnel***

<b>Telemedicine attitudes</b>	<b>Physicians (M)</b>	<b>Nonphysicians (M)</b>
Satisfaction with telemedicine technologies	1.9	1.7
Satisfaction with modality quality	2.1	1.9
Usefulness of telemedicine technologies	1.6	1.5
Perception of telemedicine/healthcare	2.0	1.7
<b>Note. Lower attitude scores indicate more positive attitudes.</b>		

The trend extended to the questions from which each attitude variable score was derived. Each of the 4 attitude variables consisted of 5 to 7 different questions. The nonphysicians showed more favorable attitude scores on the majority of questions within each of the 4 attitude variables. For example, when answering questions about their satisfaction with different technologies, the nonphysicians indicated greater satisfaction than the physicians on 5 of the 7 technologies. In particular, the nonphysicians were more satisfied than the physicians on the RMS and VTC. On the other hand, the physicians were more satisfied with store-and-forward and email than the nonphysicians.

Responding to questions about their satisfaction with specific modes of transmitted information, the nonphysicians rated 3 of the 5 modes higher than did the physicians. The physicians' ratings for these modes were relatively low, between "somewhat satisfied" and "undecided." The differential between the physicians and nonphysicians was particularly evident in the reactions to sound and video images transmitted via VTC. Both groups were undecided on satisfaction with faxed images. Again, the physicians were more satisfied with emailed images and store-and-forward images than the nonphysicians.

In their answers to questions about the usefulness of telemedicine technologies, the nonphysicians rated 4 out of 5 items more favorably than did the physicians. The exception was that the physicians rated store-and-forward imaging more favorably than the nonphysicians. Both groups, however, gave high ratings on the usefulness of VTC ( $M = 1.4$ ).

Questioned about their perceptions of telemedicine and healthcare, the nonphysicians gave more positive responses to 5 of 6 questions than did the physicians. The physicians, however, indicated a stronger belief than the nonphysicians that patients were satisfied with telemedicine in place of an office visit. Both physicians and nonphysicians supplied equally favorable ratings on the cost effectiveness of telemedicine ( $M = 1.4$ ). Both groups were generally undecided when asked whether the quality of healthcare via telemedicine was inferior to in-person care. This particular question received the least favorable rating of all items in the survey.

#### **4.4 Comments by Medical Personnel**

At the end of the structured question section of the survey, the medical personnel were asked if they had additional comments. Four of the nonphysicians and three of the physicians offered comments.

##### **4.4.1 Comments by Nonphysicians**

One nonphysician commented on the need for better coordination between services on telemedicine and healthcare. In addition to indicating that the VTC and RMS had a very positive impact, another nonphysician respondent expressed a desire for office desktop access to VTC. Another nonphysician commented that any technology that might reduce or make current paperwork easier would be beneficial. One nonphysician commented that archived videotapes of patient visits would be useful for later reference.

#### **4.4.2 Comments by Physicians**

Two physicians provided favorable comments about the VTC but included negative reactions to the audio quality. Another physician expressed concern about VTC use for child psychiatry. This individual believed that the audio and video quality of the current VTC system was too poor to facilitate the accurate evaluation of children. Therefore, this individual indicated that VTC evaluations for child psychiatry had been discontinued.

### **5.0 Discussion**

The present results support several conclusions:

- The ENT consultations had substantial clinical impact. Nearly half of these VTC consultations led to a change in diagnosis by the ENT specialist at NMCS D relative to the initial diagnosis by the primary provider at the remote MTF. This finding was robust, generalizing across different types of ENT conditions, patient demographics, and MTFs.
- The medical personnel in TRICARE Region 9 had substantial telemedicine experience and had generally positive attitudes toward the telecommunications technologies and the telemedicine process.
- The nonphysicians had slightly more positive attitudes about telemedicine than did the physicians. This trend was interesting but nonsignificant, given the small samples. The nonphysicians also used telemedicine more and in more ways than did the physicians.

#### **5.1 Clinical Impact**

Forty-five percent of ENT consultations led to a change in diagnosis. This finding validates the substantial rate of diagnosis change (49%) reported in the initial study of TRICARE Region 9 telemedicine (Melcer et al., 2001). The data in the previous study were difficult to interpret because some observations were missing, which may have biased the observed rate of clinical impact. The present study provided a complete and continuous sample of ENT consultations during a planned 4-month period.

This clinical finding raises further issues:

- Since the effectiveness of consultations extended to active-duty personnel, will present telemedicine procedures be cost-effective aboard ships? This question is especially pertinent since the types of ENT problems in this study (allergies, sleep-related) could influence shipboard operational efficiency. Upper respiratory conditions and allergies may be a special concern for small ships, possibly due to the restricted environments on these vessels (Blood & Griffith, 1990). Some consultations (e.g., tonsillitis-related) could determine the need for surgery and evacuation.

- Will the evaluation of consultations similar to those in this study, conducted by other ENT specialists, extend the generality of the present findings?
- Why did some consultations lead to a change in diagnosis while others did not? Further analysis combining data from the present study and the previous evaluation would allow a strong test of the predictors of clinical impact.
- Is it possible to decrease the rate of referrals based on the educational benefit of the consultation process for primary providers? With increased exposure to specialty consultations, the primary providers who generate the consults (e.g., GMO, IDC) may learn to recognize difficult diagnoses on their own. This would provide valuable training for shipboard medical duty, where the availability of consultations would be limited.

## **5.2 Attitudes and Telemedicine Experience**

The interviews with medical personnel revealed generally favorable attitudes toward telemedicine technologies and the telemedicine process. In other telemedicine studies, such positive findings on satisfaction with telemedicine have been frequently reported. It has been suggested that this is because patients and providers are not asked critical questions (Whitten & Mair, 2000).

The present questionnaire instrument was designed to include such critical questions. The ratings of medical personnel were less favorable in response to some of these questions, such as "Is the quality of care rendered through the use of telemedicine inferior to that provided in person?" Other questions that drew less favorable responses were related to satisfaction with VTC audio and video and the quality of images transmitted by fax.

Since certain critical questions did produce less favorable ratings, the overall positive outcomes appear to reflect actual satisfaction with telemedicine rather than the bias of the instrument. Also, the trend for physicians and nonphysicians to show different patterns of response suggests that the survey instrument has some predictive validity. This study has addressed several internal validity issues. The present results are supportive of the reliability and validity of the survey instrument. Further data collection would strengthen conclusions as to whether these measures produce an unbiased and reliable instrument.

The interviews showed that medical personnel, particularly physicians, were concerned that telemedicine might compromise patient care in some ways relative to in-person treatment. In contrast, most personnel agreed with statements that telemedicine optimized overall care for patients. This suggests that the personnel are willing to use telemedicine and work through its technical pitfalls to achieve the goal of providing timely, convenient, and accessible healthcare.

Perhaps, medical personnel could make more regular use of telemedicine for applications other than diagnosis confirmation. The availability of the Internet and other resources for patient and provider medical reference and education could be

stressed. For instance, the Navy information center currently operates a “virtual hospital” on-line for this purpose (<http://www.vnh.org>).

The use of VTC for ENT care in TRICARE Region 9 clearly profited from a functional infrastructure, namely the telemedicine coordinator, medical personnel, and RMS technology. One key element was certainly the continuity of personnel, such as the lead ENT specialist, during the past few years in TRICARE Region 9. This continuity provided the time and expertise to work through problems with new technology.

In some telemedicine specialties, however, such as child psychiatry, the technical limitations of VTC may have prevented the growth of a telemedicine specialty. Clearly, specific technical needs must be anticipated for each telemedicine specialty to function successfully.

The RMS allowed the primary provider and the consultant a common Internet-based system to manage and record telemedicine activity. Medical personnel reported relatively high satisfaction with the RMS, but noted the need to “work out some bugs.” TRICARE Region 9 is presently installing a next generation system to replace the RMS.

### **5.3 Physician and Nonphysician Telemedicine Profiles**

Analysis of interviews contrasted physician and nonphysician medical personnel. A small but consistent pattern of differences between these two groups emerged.

Nonphysicians reported a higher rate of telemedicine use than the physicians during the present study period. This higher rate was due to the fact that the nonphysicians often presented patients and executed the telemedicine sessions for a referring provider.

Could this higher rate of telemedicine use help to explain the nonphysicians’ more favorable attitudes toward telemedicine? Experience and exposure to telemedicine have been shown to be directly related to use and positive attitudes (Karp et al., 2000; Walters, 1996). However, the overall correlation between technology experience and telemedicine attitudes in this study was calculated and was not significant. This finding is presented here tentatively due to the small sample size.

In any case, it did appear that nonphysicians benefited from the use of telemedicine, which provided a means to resolve specialized patient healthcare problems. In contrast, the physicians’ responses seemed more skeptical. This may reflect their role as the ultimate patient care decision-makers, which may increase their focus on the limits of telemedicine. The physicians may also view telemedicine less favorably because it presents technical problems, which they lack the time or resources to resolve.

The physicians appeared to prefer email and store-and-forward technologies more than the nonphysicians. Physicians may prefer the convenience of stored records to review in detail as their schedules allow. It is also possible that they view VTC as unreliable. Given that VTC can be expensive and technically difficult, it seems important to determine how it enhances patient care relative to store-and-forward.

Medical background and the attitudes of providers have been related to the use and clinical impact of telemedicine (Karp et al., 2000; Nice, 1987). One important issue for naval applications is the contrast between physician and nonphysician medical personnel (Nice, 1987). Nonphysicians such as corpsmen provide extensive medical support for physicians (e.g., GMOs) in large shipboard medical departments (e.g., carriers, amphibious). Corpsmen provide all medical care aboard small ships (cruisers, destroyers) with little support from technology or additional medical personnel. Corpsmen must function autonomously at sea. The positive attitudes of nonphysicians on telemedicine and technology would likely enhance the success of any small ship telemedicine system.

#### **5.4 Recommendations and Future Work**

- Consider cost-effectiveness of ENT telemedicine for shipboard medical departments. Store-and-forward video with standardized exam protocols would eliminate need for live VTC bandwidth requirements (e.g., Stern et al., 1998).
- Analyze the relationship between provider training (e.g., IDC vs. GMO) and clinical impact of ENT consultations. The Lemoore facility offers an opportunity to answer this question because it has high volume and many referring providers to a central point of VTC.
- Describe MTF capabilities and relate them to telemedicine use and clinical impact.
- The collection of more data from other TRICARE regions would increase the sample size and allow two-tailed *t* tests to be run to determine if significant differences in telemedicine attitudes exist between physician and nonphysician groups. This data collection and analysis would improve the generalizability of the results to other populations.
- Explore technologies and protocols for VTC child psychiatry. Telepsychiatry has gained popularity for adult patients and in some studies of child psychiatry (Capner, 2000).



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# REPORT DOCUMENTATION PAGE

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## 13. SUPPLEMENTARY NOTES

## 14. ABSTRACT (maximum 200 words)

Telemedicine technologies, such as Internet and live videoteleconferencing (VTC), have great potential to provide specialty care for naval personnel in remote treatment facilities at sea or onshore. This study focused on the clinical impact of ear/nose/throat (ENT) consultations conducted via live VTC during a planned, 4-month study period in TRICARE Region 9. Also, interviews of physician and non-physician medical personnel assessed their attitudes and recent use of telemedicine. A total of 193 ENT consultations were conducted following referrals from primary providers at remote MTFs. Patients were mostly young, active duty military personnel. Nearly half (45%) of these consultations led to changed diagnosis by ENT specialist relative to initial diagnosis by primary provider. This rate of clinical impact generalized across different ENT conditions (e.g., tonsil, upper respiratory, hearing), age, military status and MTFs. Medical personnel reported positive attitudes on telemedicine technologies and the telemedicine process. Non-physicians reported slightly more positive attitudes than physicians and used telemedicine more often and in more ways than did physicians. These results replicated and extended a recent retrospective study on Region 9 telemedicine. The telemedicine process for specialty ENT care in Region 9 produced robust clinical impact and the medical personnel reacted very favorably.

## 15. SUBJECT TERMS

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